Clinical Predictors of Positive Computed Tomography Findings in Patients with Nasal Obstruction: A Retrospective Cohort Study

Eyal Yosefof MD[1,2,4] Yoav Horev MD[3,4], Eitan Yaniv MD[5], Collin F. Mulcahy MD FACS[6], and Dan Yaniv MD[1,4]

[1]Department of Otolaryngology, Head and Neck Surgery, Rabin Medical Center (Beilinson Campus), Petah Tikva, Israel
[2]Department of Oncology, Davidoff Center, Rabin Medical Center (Beilinson Campus), Petah Tikva, Israel
[3]Department of Otolaryngology Head and Neck Surgery, Wolfson Medical Center, Holon, Israel
[4]Gray Faculty of Medical and Health Sciences, Tel Aviv University, Tel Aviv, Israel
[5]Assuta Medical Center, Tel Aviv, Israel
[6]Department of Otolaryngology, Head and Neck Surgery, Weill Cornell Medical College, Houston Methodist Academic Institute, Houston, TX, USA

ABSTRACT **Background:** Nasal obstruction is one of the most common symptoms encountered in the otorhinolaryngology clinic, with diverse etiology including deviated nasal septum (DNS) and sinusitis. When surgical intervention is considered, the referring surgeon must decide whether preoperative imaging is indicated.

Objectives: To identify clinical and physical examination predictors associated with significant sinus findings on computed tomography (CT) imaging in patients with nasal obstruction. To define specific factors in the medical history and physical examination of patients with nasal obstruction, which are associated with positive CT findings.

Methods: We conducted a retrospective review of patients presenting with nasal obstruction. We collected demographic data, clinical and physical examination findings, CT imaging results, and surgical outcomes.

Results: A total of 242 patients were included (mean age 38.5 ± 16.8 years, 65.7% male), all of whom underwent CT imaging prior to surgery. On univariate analysis, nasal edema, ostiomeatal complex (OMC) blockage, or edema, were all associated with positive findings from the CT (defined as Lund–Mackay > 3). On multivariate analysis, OMC obstruction or edema were associated with positive CT findings.

Conclusions: A thorough patient history and detailed physical examination are essential for evaluating nasal obstruction and identifying patients who may benefit from preoperative CT imaging. Specific clinical symptoms can indicate chronic sinusitis, thus guiding surgeons to perform preoperative imaging for accurate diagnosis and targeted treatment beyond deviated nasal septum management.

IMAJ 2026; 28: 168–173

KEY WORDS: chronic sinusitis, computed tomography (CT), deviated nasal septum (DNS), nasal obstruction, ostiomeatal complex (OMC)

Nasal obstruction is a frequently encountered symptom in otorhinolaryngology, with a wide differential diagnosis [1,2]. Common etiologies include inflammatory conditions and structural abnormalities. A deviated nasal septum (DNS) is often implicated as a primary cause, although obstructive sensations may also arise from chronic sinusitis, with or without associated polyposis [3]. The diagnostic evaluation includes a thorough history, clinical examination, and, in some cases, imaging studies. DNS is the most frequent reason for referral to otorhinolaryngology for nasal obstruction [4].

A key challenge for otolaryngologists is determining whether patients with DNS will benefit from septoplasty alone, or whether their symptoms reflect a more complex condition such as chronic sinusitis or central compartment sinus disease. Thus, a detailed medical history is essential, particularly when symptoms such as headache, nasal discharge, and hyposmia are present. These symptoms may indicate underlying chronic sinusitis, beyond DNS alone.

In addition to history-taking, a detailed physical examination, including nasal endoscopy, is crucial. Findings such as polyposis, edema of the middle meatus, and nasal discharge may further suggest chronic sinusitis as a contributor to nasal obstruction [5]. When the presence of chronic sinusitis is suspected, especially when surgical intervention is considered, computed tomography (CT) is often pivotal. CT not only aids in confirming the diagnosis but also provides a roadmap for surgical planning [6]. However, CT involves exposure to ionizing radiation, is costly, and may be time-consuming.

In this study, we identified whether specific factors from medical histories and physical examinations of pa-

tients presenting with nasal obstruction could predict significant CT findings. Such predictors could influence the decision to proceed with surgery or modify the surgical approach. Identifying reliable predictors may allow for more judicious use of preoperative imaging, minimizing unnecessary radiation exposure and enhancing the efficiency of the diagnostic process.

PATIENTS AND METHODS

PATIENTS AND DESIGN

We included all patients with a chief complaint of nasal obstruction who were treated by a single otorhinolaryngologist between 2017 and 2019. All patients were systematically questioned regarding each symptom, including nasal obstruction, rhinorrhea, post-nasal drip, hyposmia, headache, and ear blockage. All patients were examined by anterior rhinoscopy and nasal endoscopy. DNS was defined as deviation of the septum from the nasal midline, demonstrated either on anterior rhinoscopy or nasal endoscopy. Deflection of less than 50% from the midline toward the lateral nasal wall was defined as mild DNS, and deviation of more than 50% from the midline was defined as severe DNS [7]. Edema of the nasal cavity was defined according to the Lund–Kennedy endoscopy scoring system as either absent, mild, or severe [8]. Ostiomeatal complex blockage was defined as contact between the middle turbinate and the lateral nasal wall that causes complete obstruction of the ostiomeatal complex.

IMAGING

Axial CT sinus scans with coronal reconstruction was the imaging modality used. Some patients were referred to the clinic for a second opinion and presented with prior CT scans. Patients who did not perform CT prior to referral were referred to CT from the clinic. The Lund–Mackay scoring system [9] was used to objectively describe the findings of the CT imaging.

It is the principal surgeon's routine practice to obtain CT imaging for all patients presenting with nasal obstruction, regardless of whether the presumed etiology is septal deviation or other clinical findings. This approach reflects the limited visualization of the posterior nasal cavity in patients with DNS and the frequent identification of additional sinus or OMC-related pathology that may contribute to nasal obstruction and require modification of the surgical plan. To define predictors for positive findings on CT, we compared all patients whose CT demonstrated a Lund–Mackay score higher than 3 to the patients whose score was 3 or lower. We also evaluated patient demographics, medical history, and physical examination findings. It is important to note that patients with a lower Lund–Mackay score still had sinus surgery as part of the surgery in some cases because in our experience many times the symptoms could be explained by obstruction of the sinuses. A full obstruction of the maxillary antrum can give a Lund–Mackay score of 2 and be very symptomatic. Patients with nasal polyps on clinical examination (63 patients) were excluded from this comparison, as imaging in all these patients demonstrated a Lund–Mackay score of 1 or higher, and a score of 4 or higher in all but one patient (98.4%).

MEDICAL AND SURGICAL TREATMENT

All patients referred to surgery were initially treated by medical treatment including saline nasal irrigation, intranasal corticosteroids, and systemic corticosteroids when appropriate, according to the EPOS guidelines [10].

The extent of surgical intervention was determined based on symptomatology, physical examination findings, and CT imaging results. For example, patients whose chief complaint was nasal obstruction, without any other symptoms and with no findings other than DNS with or without turbinate hypertrophy on physical examination and a Lund–Mackay score of 0, underwent septoplasty with or without inferior turbinate reduction. Patients whose medical history, physical examination, and imaging demonstrated findings compatible with chronic sinusitis with or without nasal polyposis or recurrent acute sinusitis underwent functional endoscopic sinus surgery (FESS) with septoplasty and inferior turbinate reduction when indicated.

STATISTICAL ANALYSIS

Differences in mean categorical variables between groups were analyzed by Fisher's exact test. Multivariate analysis was performed using the Cox regression test. A P-value < 0.05 was considered statistically significant. Statistical analyses were performed using IBM Statistical Package for the Social Sciences statistics software, version 26 (SPSS, IBM Corp, Armonk, NY, USA).

ETHICS CONSIDERATIONS

The study was approved by the Medical Center's institutional review board (IRB approval # ASMC-0068-22).

RESULTS

PATIENTS

We performed a retrospective review of 493 patients who were treated by a single otorhinolaryngology surgeon due to any nasal symptoms between 2017 and 2019. Of this group, 242 (49.1%) had a chief complaint of nasal obstruction and were included in the study's cohort. Of these patients, 32% were referred by an otolaryngologist for nasal septal surgery, 25% were referred by their primary care physician for further workup of nasal obstruction, and 43% were self-referred to the clinic. The patient's medical files were reviewed and data regarding demographics, clinical, radiological, and surgical findings were obtained.

The mean age of patients was 38.5 ± 16.8 years; 159 were male (65.7%). Nasal obstruction was bilateral in 159 patients (65.7%), and in 80 cases unilateral (33.1%). No data regarding laterality of the obstruction was provided for 3 patients (1.2%). Regarding medical history, other common symptoms reported by patients with obstruction included rhinorrhea in 166 patients (68.6%), post-nasal drip among 157 (64.9%), hyposmia in 130 (53.7%), headache in 108 (44.6%), and aural fullness in 51 (21.1%). Thirty patients (12.4%) had been diagnosed with asthma.

On physical examination, 233 patients had deviated nasal septum (DNS) (96.3%), of them severe DNS was demonstrated in 131 patients (54.1%) and mild DNS in 102 patients (42.2%). Hypertrophy of the inferior turbinates was demonstrated in 229 patients (94.6%). Mild or severe edema of the nasal cavity was described in 123 patients (50.9%). Nasal discharge was documented in 42 cases (17.4%). Ostiomeatal complex (OMC) edema was demonstrated in 95 patients (39.3%), and obstruction of the OMC (most commonly due to DNS) was described in 188 patients (77.7%). Nasal polyposis was demonstrated in 63 patients (26%).

IMAGING

All patients underwent CT prior to surgical intervention. Of them, 95 (39.3%) already arrived at the clinic with a CT, and 147 (60.7%) were referred to the exam from the clinic. DNS was demonstrated among 233 patients (96.3%). Unilateral concha bullosa was present in 46 cases (19%), and bilateral concha bullosa in 20 patients (8.3%). Nasal polyps were demonstrated in 68 patients (28.1%). The mean Lund–Mackay score was 8.1 (range 0–24). For 40 patients (16.5%) the score was 0, for 31 (12.8%) it was 1–3, and in 171 patients the score was 4 or higher (70.7%).

Table 1 summarizes relevant data regarding demographics, clinical and radiological data regarding the cohort.

Table 1. Characteristics of 242 patients presenting with nasal obstruction

Variable	Nasal obstruction referral, n (%)
Mean age in years	38.5 ± 16.8
Symptoms	
Rhinorrhea	166 (68.6)
Post-nasal drip	157 (64.9)
Headache	108 (44.6)
Hyposmia	130 (53.7)
Ear blockage	51 (21.1)
DNS	
No	9 (3.7)
Mild	102 (42.2)
Severe	131 (54.1)
Turbinate hypertrophy	**229 (94.6)**
Nasal edema	
No	119 (49.1)
Mild	87 (36)
Severe	36 (14.9)
Nasal drainage	
None	200 (82.6)
Serious	5 (2.1)
Mucoid	21 (8.7)
Purulent	16 (6.6)
OMC block	
Open	54 (22.3)
Close	188 (77.7)
OMC edema	
No	147 (60.7)
Yes	95 (39.3)
Nasal polyps	
No	179 (74)
1	12 (5)
2	9 (3.7)
3	31 (12.8)
4	11 (4.5)
Lund–Mackay score	
0	40 (16.5)
1–3	31 (12.8)
4+	171 (70.7)

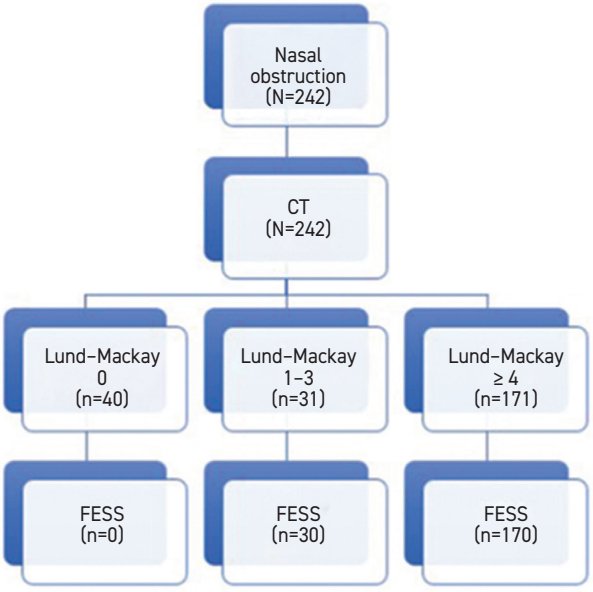
DNS = deviated nasal septum, OMC = ostiomeatal complex

SURGERY

Surgery included septoplasty for 237 patients (97.9%) while inferior turbinate reduction was performed for 236 patients (97.5%). FESS was performed in 200 cases (82.6%). Figure 1 demonstrates the correlation between findings on CT and surgical treatment that included FESS. Figure 1 illustrates the distribution of surgical management according to CT findings, based on Lund–Mackay scores.

Figure 1. Surgical treatment according to findings on computerized tomography

CT = computed tomography, FESS = functional endoscopic sinus surgery



COMPARISON BETWEEN PATIENTS WITH POSITIVE (≥ 4) AND NEGATIVE CT EXAMS

After excluding patients with nasal polyps from the analysis (63 patients), we compared 70 patients with a Lund–Mackay score of 0–3 with 109 patients with a score of ≥ 4. Regarding medical history, no specific patient's complaints or symptoms were associated with higher risk for a Lund–Mackay score > 3. On physical examination, the presence of nasal edema was associated with high Lund–Mackay (48.6% vs. 22.9%, $P < 0.001$), as well as OMC edema or OMC obstruction (33% vs. 5.7%, $P < 0.001$ and 81.7% vs. 54.3%, $P < 0.001$). The comparison between patients with a Lund–Mackay score 0–3 to a Lund–Mackay score ≥ 4 is shown in Table 2.

Table 2. Comparison of patients with Lund–MacKay score 0–3 to patients with score > 3 in 179 patients without nasal polyposis

Variable	Lund–Mackay 0–3 (n=70), n (%)	Lund–Mackay > 3 (n=109), n (%)	*P*-value
Mean age	37.9	38.8	0.14
Rhinorrhea	38 (54.3)	74 (67.9)	0.066
Post-nasal drip	38 (54.3)	73 (67)	0.088
Headache	30 (42.9)	49 (45)	0.78
Hyposmia	27 (38.6)	51 (46.8)	0.28
Ear blockage	14 (20)	18 (16.5)	0.55
DNS			
No	3 (4.3)	2 (1.8)	0.332
Mild	20 (28.6)	52 (47.7)	
Severe	47 (67.1)	55 (50.5)	
Turbinate hypertrophy	68 (97.1)	101 (92.7)	0.2
Nasal edema			
No	54 (77.1)	56 (51.4)	< 0.001
Mild	16 (22.9)	34 (31.2)	
Severe	0	19 (17.4)	
Nasal drainage			
None	63 (90)	89 (81.7)	0.34
Serous	2 (2.9)	3 (2.8)	
Mucoid	4 (5.7)	10 (9.2)	
Purulent	1 (1.4)	7 (6.4)	
OMC block			
Open	32 (45.7)	20 (18.3)	< 0.001
Close	38 (54.3)	89 (81.7)	
OMC edema			
No	66 (94.3)	73 (67)	< 0.001
Yes	4 (5.7)	36 (33)	

DNS = deviated nasal septum, OMC = ostiomeatal complex

MULTIVARIATE ANALYSIS OF PREDICTORS FOR POSITIVE CT FINDINGS (≥ 4 OR MORE)

As several factors were associated with positive CT findings, we performed a multivariate analysis to try and define certain predictors in patient's complaints or physical exam for positive findings on CT. The analysis is shown in Table 3. Our analysis demonstrated that physical examination findings of OMC obstruction and OMC edema were significantly associated with a Lund–Mackay score of ≥ 4 on CT (odds ratio [OR] 2.34, 95% confidence interval [95%CI] 1.08–5.07, *P*-value = 0.031; and OR 4.53, 95%CI 1.28–16.1, *P*-value = 0.019, respectively).

Table 3. Multivariate analysis of the association of patient's complaints and physical examination findings on positive computerized tomography findings (Lund–Mackay > 3)

Variable	Multivariate analysis: *P*-value	Multivariate analysis: odds ratio	95% confidence interval
Nasal blockage	0.255	1.499	0.746–3.010
Rhinorrhea	0.616	1.208	0.578–2.526
Post-nasal drip	0.441	1.334	0.641–2.779
Headache	0.463	0.762	0.370–1.572
Hyposmia	0.914	0.961	0.467–1.977
Ear blockage	0.312	0.627	0.253–1.551
OMC Block	0.031	2.339	1.079–5.070
OMC edema	0.019	4.529	1.277–16.063
Nasal drainage	0.791	1.068	0.658–1.732
Severe DNS	0.091	0.541	0.265–1.104
Nasal edema	0.878	1.071	0.446–2.571

DNS = deviated nasal septum, OMC = ostiomeatal complex

DISCUSSION

Our analysis of 242 patients presenting with nasal obstruction revealed that 70.7% demonstrated CT findings consistent with sinusitis (Lund–Mackay score ≥ 4), reinforcing the importance of accurately distinguishing between mechanical and inflammatory causes of obstruction. While a DNS is a common finding, our data suggest that symptoms alone are insufficient to guide surgical planning without considering CT imaging.

Previous studies have reported limited correlation between subjective nasal obstruction and objective CT findings [11-14]. Ardeshirpour et al. [2] and Wotman and colleagues [15] both noted poor alignment between patient-reported symptoms and radiological severity. Similarly, Berenholz and co-authors [16] found that incidental findings on CTs altered the surgical plan in a substantial proportion of cases, despite the absence of clear clinical indicators. However, these studies did not identify specific symptoms or exam findings predictive of positive imaging.

Our study results showed that OMC edema or obstruction were independently associated with positive CT findings. This finding aligns with data from Rathor and Bhattacharjee [6], who emphasized the diagnostic value of OMC assessment in chronic rhinosinusitis. OMC obstruction disrupts mucociliary clearance, leading to stasis and bacterial colonization, a well-known mechanism in the pathogenesis of chronic rhinosinusitis [6]. This finding likely explains the predictive value of OMC findings on endoscopy in our cohort.

Unintuitively, our results demonstrated no association between patient complaints about headache and hyposmia and positive CT findings. This condition might be due to the retrospective design of our study, but another reason might be that not all symptoms necessarily correlate perfectly with radiological finding when dealing with sinusitis, as demonstrated by other authors. Kemal et al. [17] found no relationship between symptoms and paranasal sinus CT findings in patients with chronic rhinosinusitis. Amodu et al. [18] compared Lund–Mackay scores patient reported outcomes using the visual analog scale and found that there was a significant correlation between CT scores and nasal discharge (r=-0.132; P = 0.03) and nasal obstruction (r=0.193; P = 0.049), but no correlation with other symptoms.

Karataş et al. [9] and Carmel-Neiderman and colleagues [19] also demonstrated that CT imaging before septoplasty often results in modification of the surgical approach, especially when alternative or additional pathology is detected. Our results support incorporating structured symptom review and focused nasal examination, particularly for OMC changes, to guide imaging decisions.

In the future, incorporating our predictors into a clinical scoring system could assist physicians in deciding when CT is warranted, potentially reducing unnecessary imaging without compromising diagnostic accuracy. Prospective validation and integration of quality-of-life measures or surgical outcomes could further clarify the predictive utility of these clinical markers and refine imaging guidelines.

Limitations of our study include its retrospective design and the absence of post-treatment quality-of-life outcomes. Nonetheless, the consistency of our findings with existing literature and our relatively large cohort strengthen the reliability of our conclusions.

CONCLUSIONS

Our study results support a more selective and evidence-based approach to CT imaging in patients with nasal obstruction. Specific physical examination findings including OMC obstruction or edema significantly correlate with sinus pathology on imaging. Physicians should consider preoperative CT in patients with these features. Implementing these predictors into clinical

evaluation could improve diagnostic accuracy, optimize surgical planning, and reduce unnecessary radiation exposure.

Correspondence

Dr. E. Yosefof
Dept. of Otolaryngology, Head and Neck Surgery, Rabin Medical Center (Beilinson Campus), Petah Tikva 49100, Israel
Phone: (972-3) 937-6457
Fax: (972-3) 937-6467
Email: eyalyos@gmail.com

References

1. Chandra RK, Patadia MO, Raviv J. Diagnosis of nasal airway obstruction. *Otolaryngol Clin North Am* 2009; 42 (2): 207-25, vii.
2. Ardeshirpour F, McCarn KE, McKinney AM, et al. Computed tomography scan does not correlate with patient experience of nasal obstruction. *Laryngoscope* 2016; 126 (4): 820-5.
3. Yaniv E, Hadar T, Shvero J, Raveh E. Objective and subjective nasal airflow. *Am J Otolaryngol* 1997; 18 (1): 29-32.
4. Karataş D, Yüksel F, Şentürk M, et al. The contribution of computed tomography to nasal septoplasty. *J Craniofac Surg* 2013; 24 (5): 1549-51.
5. Gardiner LA, Goyal LK, McCoy JL, Gillman GS. The role of nasal endoscopy in the preoperative evaluation of nasal airway obstruction. *Otolaryngol Head Neck Surg* 2023; 169 (5): 1329-34.
6. Rathor A, Bhattacharjee A. Clinical-radiological correlation and role of computed tomography staging in chronic rhinosinusitis. *World J Otorhinolaryngol Head Neck Surg* 2017; 3 (3): 169-75.
7. Teixeira J, Certal V, Chang ET, Camacho M. Nasal septal deviations: a systematic review of classification systems. *Plast Surg Int* 2016; 2016: 7089123.
8. Lund VJ, Kennedy DW. Quantification for staging sinusitis. The Staging and Therapy Group. *Ann Otol Rhinol Laryngol Suppl* 1995; 167: 17-21.
9. Lund VJ, Mackay IS. Staging in rhinosinusitus. *Rhinology* 1993; 31 (4): 183-4.
10. Fokkens WJ, Lund VJ, Hopkins C, et al. Executive summary of EPOS 2020 including integrated care pathways. *Rhinology* 2020; 58 (2): 82-111.
11. Janovic N, Janovic A, Milicic B et al. Is computed tomography imaging of deviated nasal septum justified for obstruction confirmation? *Ear Nose Throat J* 2021; 100 (2): NP131-NP136.
12. Lebowitz RA, DoudGalli SK, Holliday RA et al. Nasal septal deviation: a comparison of clinical and radiological evaluation. *Oper Tech Otolayngol Head Neck Surg* 2001; 12 (2): 104-6.
13. Sedaghat AR, Kieff DA, Bergmark RW, et al. Radiographic evaluation of nasal septal deviation from computed tomography correlates poorly with physical exam findings. *Int Forum Allergy Rhinol* 2015; 5: 258-62.
14. Lee DC, Shin JH, Kim SW, et al. Anatomical analysis of nasal obstruction; nasal cavity of patients complaining of stuff nose. *Laryngoscope* 2013; 123: 1381-4.
15. Wotman M, Kacker A. What are the indications for the use of computed tomography before septoplasty? *Laryngoscope* 2016; 126 (6): 1268-70.
16. Berenholz L, Kessler A, Lapinsky J, et al. Nasal obstruction in the adult: is CT scan of the sinuses necessary? *Rhinology* 2000; 38 (4): 181-4.
17. Kemal O, Müderris T, Kutlar G, Gül F. Topographic relationship; sinusitis and paranasal sinus computed tomography. *B-ENT* 2016; 12 (2): 103-9.
18. Amodu EJ, Fasunla AJ, Akano AO, Daud Olusesi A. Chronic rhinosinusitis: correlation of symptoms with computed tomography scan findings. *Pan Afr Med J* 2014; 18: 40.
19. Carmel-Neiderman NN, Safadi A, Wengier A, et al. The role of imaging in the preoperative assessment of patients with nasal obstruction and septal deviation-a retrospective cohort study. *Int Arch Otorhinolaryngol* 2021; 25 (2): e242-e248.

Capsule

Bordetella attacking cilia

Bordetella bacteria infect the airways of animal hosts by sticking to cilia that line the respiratory tract. **Costello** and colleagues showed that these pathogens use a special adhesive protein that helps them attach to the host cell surface and that interacts with microtubules inside the. These interactions help the bacteria move from the tips of the cilia to the base. Bacteria in this basal niche are not swept away by normal airway cleaning mechanisms, explaining why *Bordetella* lacking this protein are unable to colonize the host respiratory tract effectively.

Science 2026; 391: 825
Eitan Israeli

Capsule

Taming oncogenic signaling for leukemias

CD25 is a subunit of the interleukin-2 (IL-2) receptor on T cells, but CD25-expressing cells in some leukemias do not respond to IL-2 and are associated with poor clinical outcomes. Through experiments with mice and patient-derived xenografts, **Lee** et al. showed that loss of CD25 in acute leukemia resulted in hyperactive oncogenic tyrosine kinase signaling that reduced cell fitness and leukemic potential. Phosphorylation of CD25 by protein kinase Cδ resulted in the recruitment of inhibitory phosphatases that stabilized fluctuations in tyrosine kinase signaling, promoting leukemic growth. Mice with patient-derived leukemia went into remission when treated with a CD25-targeting antibody-drug conjugate, suggesting that this pathway could be explored for treating patients with susceptible leukemias.

Sci Transl Med 2026; 19 (924): eadw5054
Eitan Israeli